



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:

Keiichi TANAKA et al.

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For: PRODUCTION OF HIGH-FUNCTION PHOTOCATALYST

DECLARATION UNDER 37 C.F.R. § 1.132

Commissioner for Patents

P.O. Box 1450

Alexandria, VA 22313-1450

Sir:

I, Keiichi TANAKA, hereby declare and state that:

1. I am a Japanese citizen residing at c/o JICA office, Fountain Plaza, Abdel Rahim, Haj-Mohammad Street, Sweifieh, Amman, Jordan.

I received a Bachelor's degree from Undergraduate Course of Chemistry, Kyushu University, in March 1963, I was awarded PhD from Kyushu University in 1975.

From April 1975, I was employed by National Institute of Chemical Industry, Agency of Industrial Science and Technology, Ministry of International Trade and Industry, which changed to the National Institute of Materials and Chemical Research in 1993, now changed to National Institute of Advanced Industrial Science and Technology from January 2001. In 1975, I was appointed as a Senior Research Scientist of Research Institute for Chemical Technology, and I had worked at said institute until I retired therefrom in 2000.

From 2001 to 2004, I worked at Oita University as a professor of Applied Chemistry Department.

Since 2004 to date, I have been working for JICA(Japan International Cooperation Agency), and been appointed as a professor of Jordan University in Jordan.

I have been thus engaged in research and development of photocatalysts for more than 20 years in the institutes.

I am one of the joint inventors of the subject matter of the United States Patent Serial No.09/786,626, filed on October 11, 2001, and am thus intimately familiar with the contents of the application, its prosecution before the United States Patent & Trademark Office, and the references cited therein.

2. I have studied the contents of the cited Murasawa et al.'s U.S. Patent No. 5,547,823 and Eckberg's U.S. Patent No. 5,583,195.

3. To show the superiority of the present invention to the prior art, I conducted the experiments described below:

### Experiments

#### (Experiment 1)

To demonstrate an embodiment of the present invention, an experiment was conducted as follows.

To 0.18 ml of a 5 wt% commercial Nafion solution, 1 ml of methanol was added, and 2 g of titanium dioxide powder was mixed into the solution (the amount of Nafion mixed with the titanium dioxide corresponds to 4.5 mg/g), and the mixture was dried overnight at room temperature. In 500 ml of  $10^{-4}$  mol/l solution of the herbicide paraquat, 2 g of titanium dioxide, covered with the above-described Nafion, was suspended. The suspension was irradiated with a blacklight of 6 W placed inside the liquid.

By stirring the suspension for 120 minutes, before the blacklight irradiation, 10% or less of the initial concentration of the herbicide was decreased from the suspension.

Then, after 10 minutes of irradiation with the blacklight, 60% of the initial concentration ( $0.6 \times 10^{-4}$  mol/l) of the herbicide was decomposed.

**(Comparative Experiment 1)**

As a comparative example, an experiment was conducted, to show the result in the case of an excessive amount of the polymer provided.

The same procedure as in Experiment 1 was conducted, except that 1.8 ml of Nafion solution was used with 2 g of titanium dioxide (the amount of Nafion mixed with the titanium dioxide corresponds to 45 mg/g).

By stirring the suspension for 120 minutes, before the blacklight irradiation, 50% of the initial concentration of the herbicide was decreased from the suspension.

Then, after 10 minutes of irradiation with the blacklight, 45% of the initial concentration ( $0.45 \times 10^{-4}$  mol/l) of the herbicide was decomposed.

**(Comparative Experiment 2)**

To show the result in the case of a further excessive amount of the polymer provided, another comparative experiment was conducted.

The same procedure as in Experiment 1 was conducted, except that 2.7 ml of Nafion solution was used with 2 g of titanium dioxide (the amount of Nafion mixed with the titanium dioxide corresponds to 67.5 mg/g).

By stirring the suspension for 120 minutes, before the blacklight irradiation, 90% of the initial concentration of the herbicide was decreased from the suspension. Since almost no herbicide was left in the suspension, light-irradiating examination was not conducted.

(Conclusion)

The results obtained in the experiments above are shown in Table A below.

Table A

	Experiment 1	Comparative Experiment 1	Comparative Experiment 2
Amount of Nafion provided on photocatalyst	4.5 mg/g	45 mg/g	67.5 mg/g
Adsorbed amount of herbicide after stirring for 120 min.	10% ( $0.1 \times 10^{-4}$ mol/l)	50% ( $0.5 \times 10^{-4}$ mol/l)	90% ( $0.9 \times 10^{-4}$ mol/l)
Photocatalytic decomposition amount of herbicide with 10-minutes light irradiation	60% ( $0.6 \times 10^{-4}$ mol/l)	45% ( $0.45 \times 10^{-4}$ mol/l)	Not conducted

Referring to the results, as demonstrated in Experiment 1, according to the present invention, photocatalytic decomposition of the pollutant material was accomplished to 60% of the initial concentration with 10-minutes light irradiation.

On the other hand, according to Comparison Experiment 1, 50% of the pollutant material was adsorbed, and the photocatalytic decomposition amount was reduced to 45% thereof. Further, according to Comparison Experiment 2, since 90% of the pollutant material was adsorbed, the subsequent photocatalytic examination was not conducted.

From these results, it can be understood that an excessive amount of the polymer interrupts photocatalytic activity, due to irreversible adsorption of the pollutant material, and due to obstruction of light irradiation.

Thus, it should be apparent that the data already recorded in the specification, and the supplemental data submitted herewith, demonstrate unexpectedly superior results of the claimed invention of a high-function photocatalyst, and the subject matter of the present invention is unforeseeable from the cited references.

4. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Date: July 5, 2005

Keiichi Tanaka  
Keiichi TANAKA